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(54) **FREEWHEELING ELEMENT**

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F16D 41/067 (2006.01)

(52) **U.S. Cl.**

CPC ***F16D 41/076*** (2013.01); ***F16C 33/38*** (2013.01); ***F16D 41/067*** (2013.01)

(58) **Field of Classification Search**

CPC F16D 41/067; F16D 41/076; F16C 33/38
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,006,447 A 10/1961 Irwin
5,664,653 A 9/1997 Kurita

FOREIGN PATENT DOCUMENTS

DE 1264886 * 4/1966 .... F16D 41/07
DE 1264886 B 3/1968
DE 1267039 B 4/1968
DE 102006038201 A1 2/2009
EP 2660448 B1 7/2017

* cited by examiner

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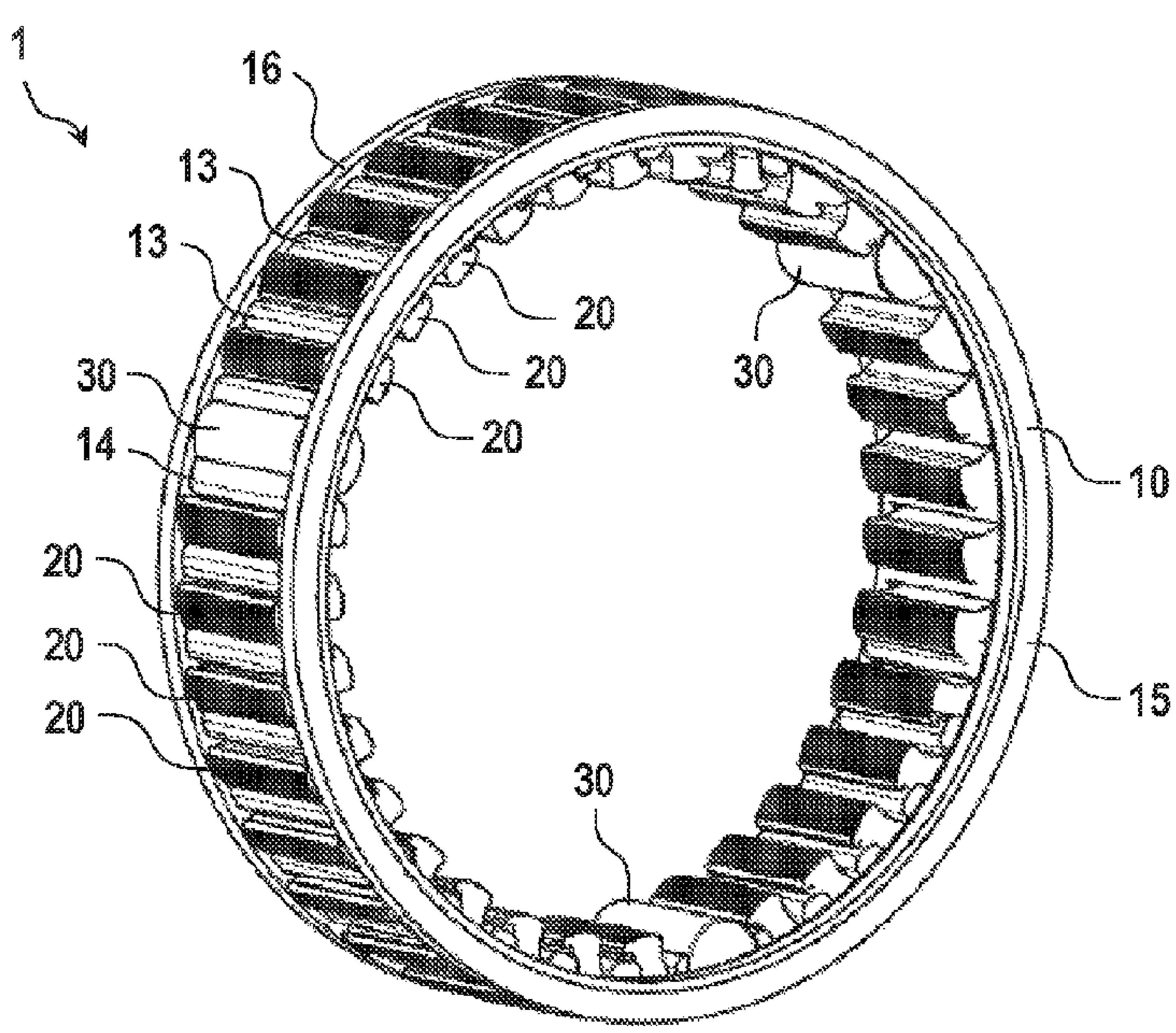
(57) **ABSTRACT**

The invention relates to a freewheeling element comprising a cage, a plurality of clamping bodies, each of the clamping bodies being received in an associated clamping body pocket formed in the cage, and a plurality of rolling bodies, each of the rolling bodies being received in an associated rolling body pocket formed in the cage, the cage having a higher resilience than the clamping bodies and the rolling bodies.

12 Claims, 3 Drawing Sheets



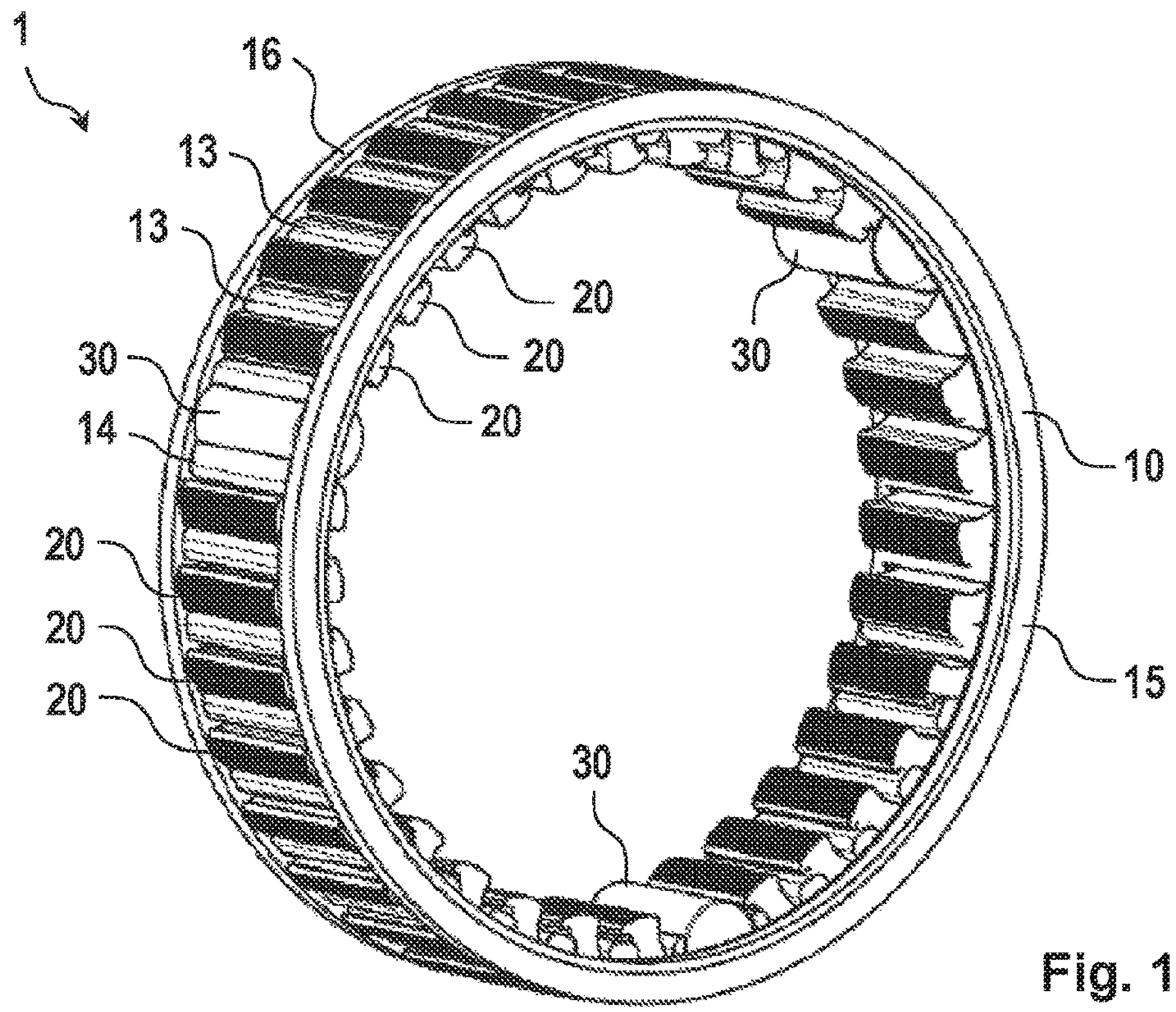


Fig. 1

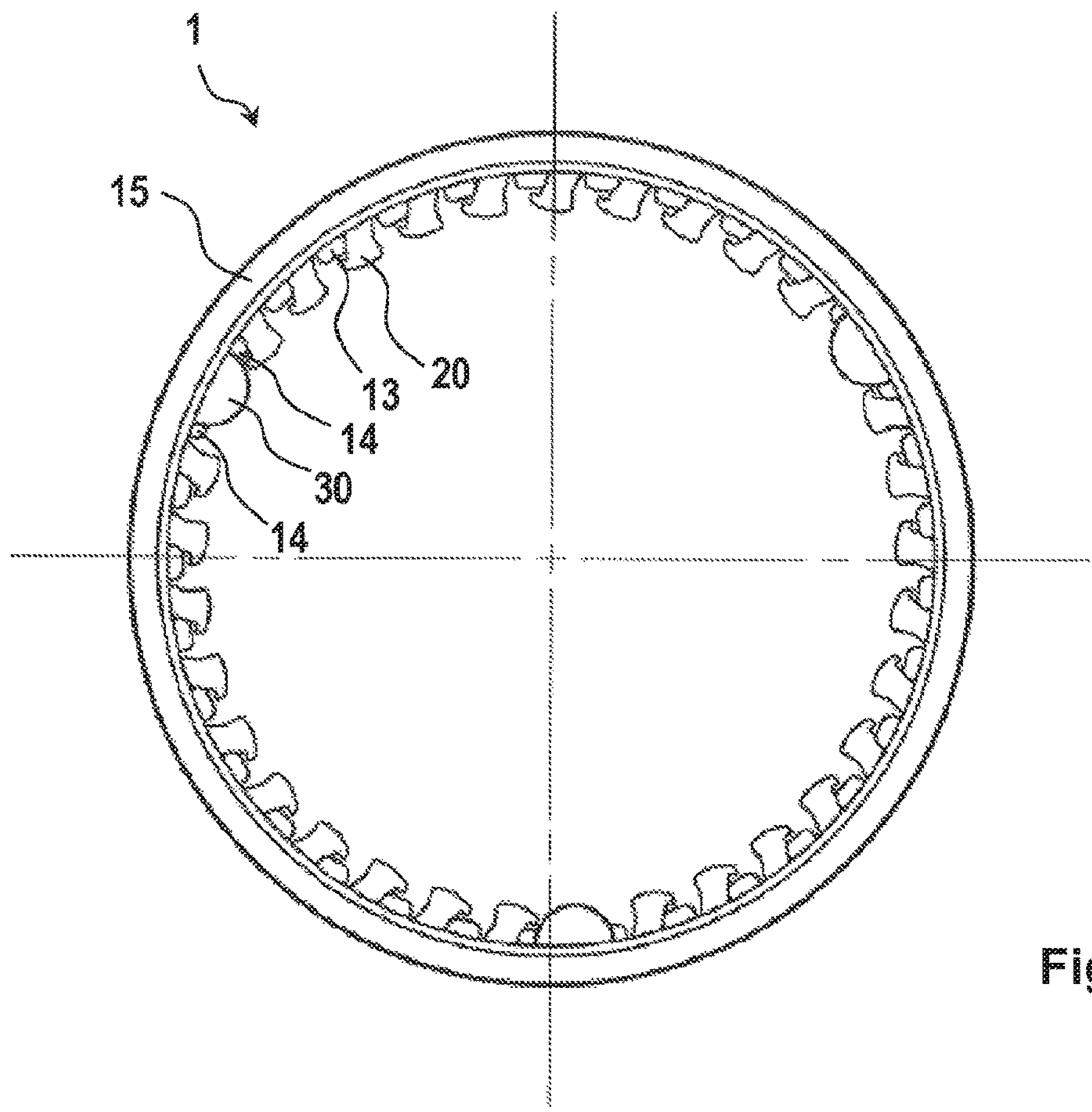


Fig. 2

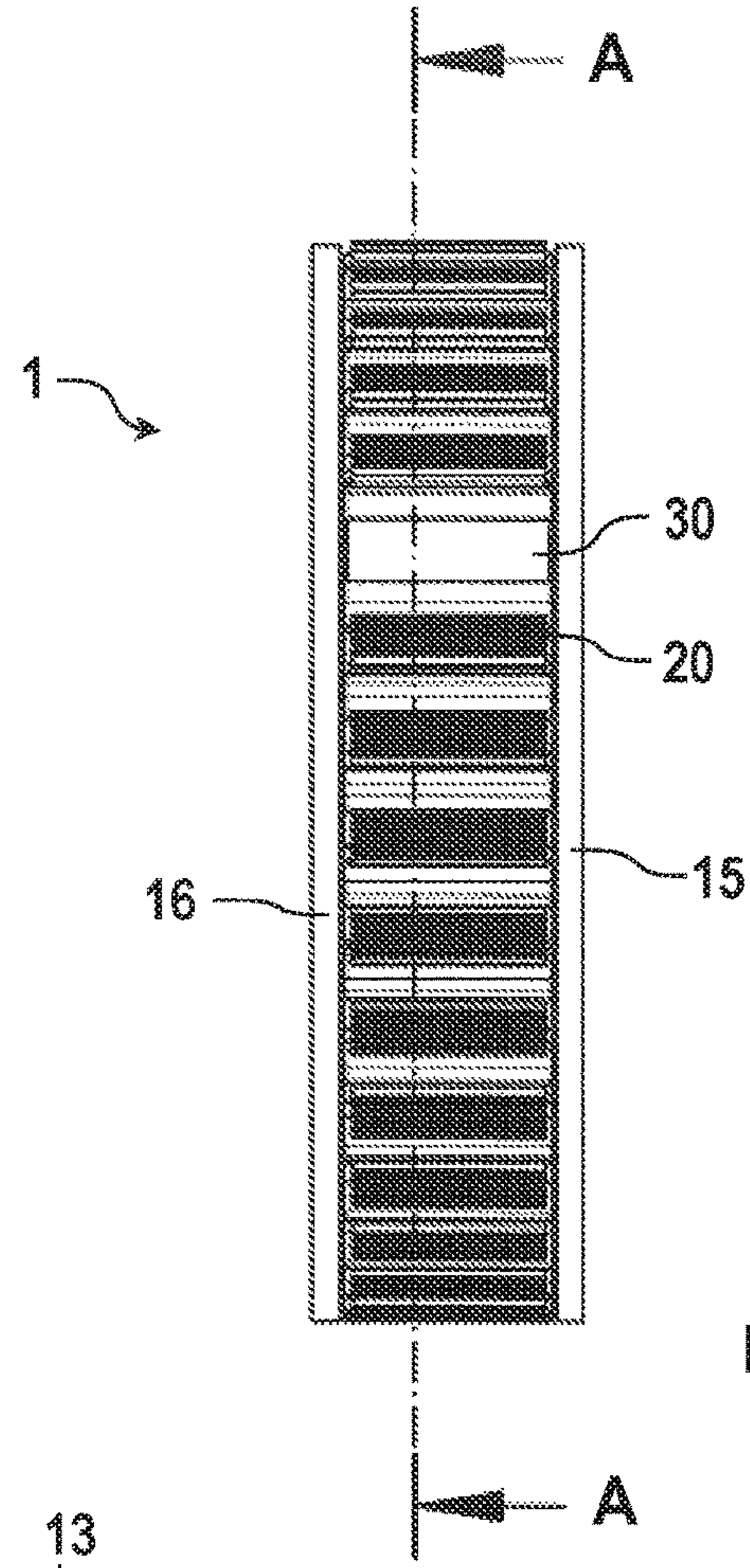


Fig. 3

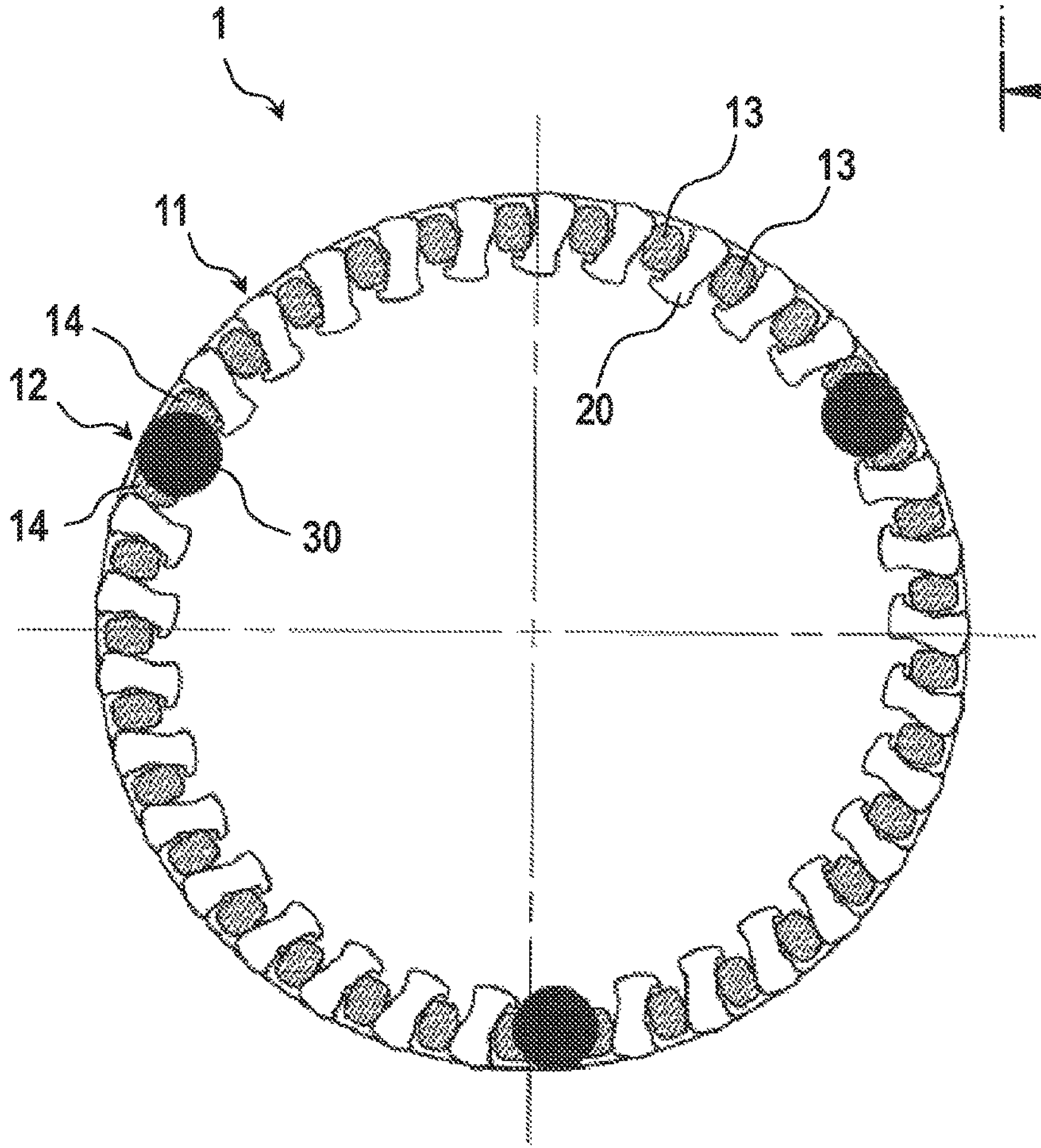


Fig. 4

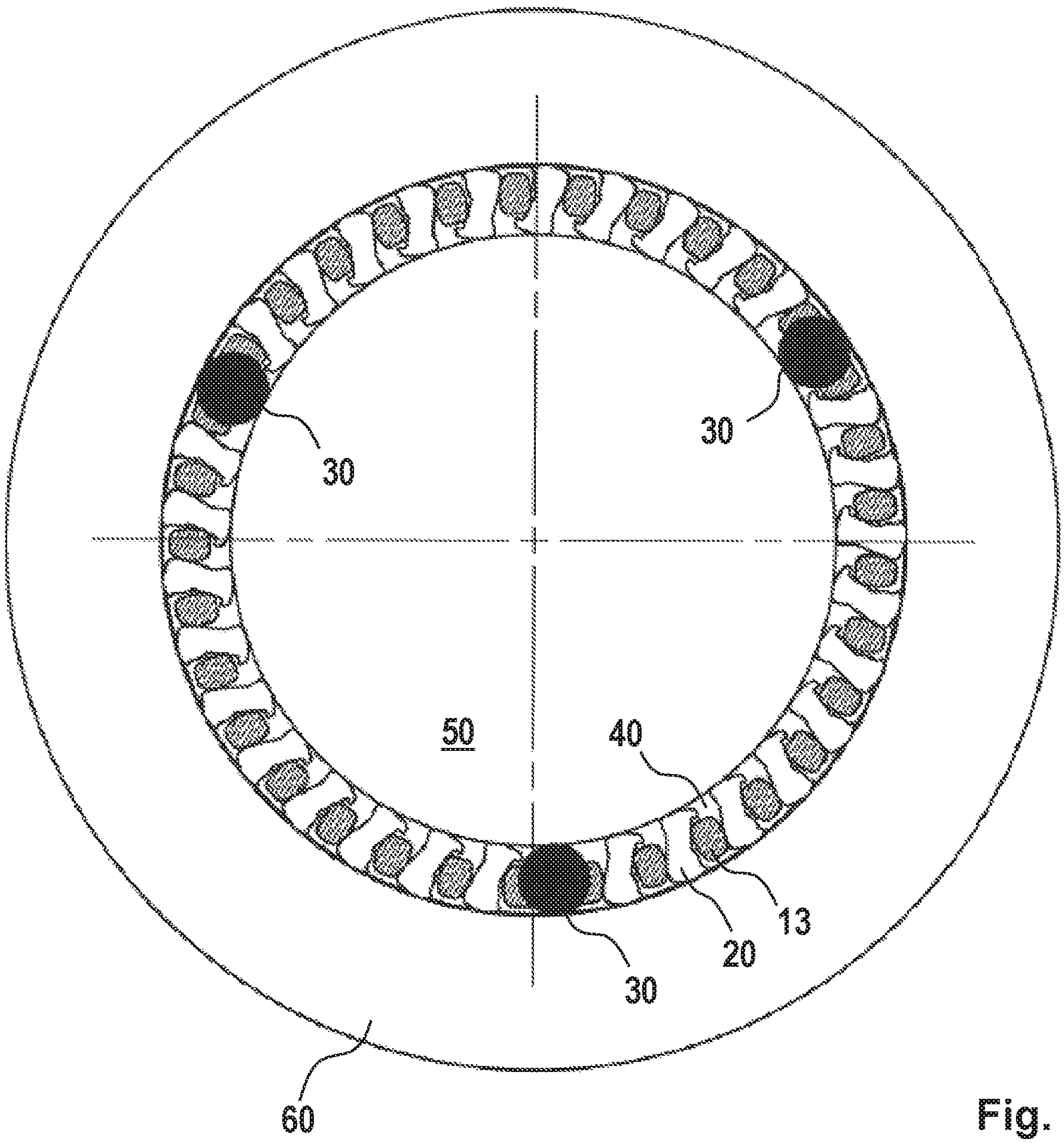


Fig. 5

FREEWHEELING ELEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS AND PRIORITY

This patent application claims priority from PCT Application No. PCT/DE2020/100914 filed Oct. 23, 2020, which claims priority from German Patent Application No. 20 2019 106 004.2 filed Oct. 29, 2019. Each of these patent applications are herein incorporated by reference in their entirety.

TECHNICAL FIELD

The invention relates to a freewheeling element.

BACKGROUND OF THE INVENTION

Freewheeling elements are used, for example, in directional clutches which, in one direction, transmit and/or support a torque by way of a force fit and, in the opposite direction, allow idling. In the case of sprag clutches, sprags are located in the so-called clamping position when they are transmitting the torque by a force fit, i.e. a friction fit, and are located in the so-called freewheeling position when they allow idling.

In addition to the sprags, conventional sprag clutches have, inter alia, a cage, in which the sprags are accommodated in pockets. Such a sprag clutch is disclosed in EP 2 660 488 A1. The disadvantage with prior-art sprag clutches is that additional mounting is required, since a classic freewheel does not have any bearing property, and therefore has no load-bearing capacity.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a freewheeling element which has load-bearing capacity integrated in it.

This object is achieved by a freewheeling element having the features of claim **1**. Advantageous embodiments of the freewheel are described in the dependent claims.

The freewheeling element according to the invention has a cage, a plurality of sprags, and a plurality of rolling bodies. Each of the sprags is accommodated in a respective sprag pocket formed in the cage. Each of the rolling bodies is accommodated in a respective rolling-body pocket formed in the cage. The cage has a higher level of elasticity than the sprags and the rolling bodies.

The provision of rolling bodies allows the load-bearing capacity to be integrated in the freewheeling element. Furthermore, the higher level of elasticity in comparison with the sprags and the rolling bodies means that the cage acts as a resilient element. Otherwise required metallic springs in the form of spring-loading elements can thus be dispensed with. In addition, selecting a cage material with a certain level of elasticity makes it possible for the spring-loading behavior of the sprags and/or the positional stability of the rolling bodies to be adjusted over a wide range.

The sprags and the rolling bodies are preferably produced from a metallic material, in particular from a steel material. Accordingly, the cage then has a level of elasticity which is greater than the elasticity of metallic materials. However, it is also possible to use, for example, rolling bodies made of a ceramic material. In this case, the cage then has a level of elasticity which is greater than that of the metallic and ceramic materials used.

The rolling-body pockets—and therefore also the rolling bodies accommodated in these rolling-body pockets—are preferably distributed in an equidistant manner over the circumference of the cage. This makes it possible to achieve uniform support along the circumference and to increase the load-bearing capacity of the freewheel in a correspondingly uniform manner.

The provision of an odd number of rolling-body pockets along the circumference of the cage has been found to be advantageous. It is particularly advantageous here for three, five or seven rolling-body pockets distributed in an equidistant manner to be provided. The greater the number of rolling bodies, the greater is the load-bearing capacity, although this is at the expense of the freewheeling character of the element.

In an advantageous embodiment, the rolling bodies are accommodated in the rolling-body pockets in a form-fitting manner, in particular in the manner of a latching or snap-fit connection. On the one hand, this allows the rolling bodies to be easily installed and removed; on the other hand, reliable mounting of the rolling bodies can be achieved. The elastic property of the cage material allows the rolling-body pocket to be expanded elastically in order for the rolling body to be latched or snap-fitted into the pocket.

In an advantageous embodiment, the cage consists of a polymer material, in particular of a polyamide. The polymer material preferably contains fillers, in particular in the form of fibers and/or balls. Glass-fiber-reinforced polyamide, particularly preferably PA 66 GF 25 (polyamide with a 25% glass-fiber fraction) is a particularly suitable material for the cage. It is possible for just the regions of the cage around the rolling-body pockets and/or the sprag pocket and for the entire cage to consist of the aforementioned materials. Use of the aforementioned materials makes it possible to achieve a particularly advantageous resilient behavior of the cage. It is also possible, by selecting the material and/or the mixing ratio of basic polymer substance to filler, to adapt the level of elasticity and the resilient behavior of the cage.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is explained further with reference to an exemplary embodiment in the figures, in which:

FIG. **1** shows a perspective view of a freewheeling element;

FIG. **2** shows a front view of the freewheeling element from FIG. **1**;

FIG. **3** shows a side view of the freewheeling element from FIG. **2**;

FIG. **4** shows a sectional view taken along section plane A-A from FIG. **3**; and

FIG. **5** shows an example of an installed state of the freewheeling element illustrated in FIG. **4**.

DETAILED DESCRIPTION

The freewheeling element **1** illustrated in the figures is of essentially annular design and has a cage **10** made of a polymer material (e.g. polyamide 66 with a 25% glass-fiber fraction). A plurality of sprag pockets **11** and a total of three rolling-body pockets **12** are formed in the cage **10**. For reasons of clarity, not all the elements which appear a number of times are provided with a separate reference sign in the figures. Thus, for example, just one sprag pocket **11** is provided with a reference sign in FIG. **4**. The sprag pockets **11** and the rolling-body pockets **12** here constitute apertures and/or holes in the cage **10**. In other words, the cage **10** has axially running first and second crosspieces **13** and **14** and also annular terminating flanges **15**, **16**. The spatial volume between in each case two adjacent crosspieces **13**, **14** and the two terminating flanges **15**, **16** forms in each case a sprag pocket **11** and a rolling-body pocket **12**. The crosspieces **13** are each essentially cuboidal and have a convex cross section in the axial direction of the freewheeling element **1**. In each case a plurality of sprag pockets **11** are arranged, between two rolling-body pockets **12**, in the circumferential direction of the freewheeling element.

A respective sprag **20** is accommodated in each of the sprag pockets **11**. The connection between the sprag **20** and cage **10** here is designed in the form of a snap-fit connection. The sprags **20** are produced from a steel material.

A respective rolling body **30** is accommodated in each of the rolling-body pockets **12**, wherein the rolling body **30** is designed in the form of a cylindrical roller and is produced from a steel material. The connection between the rolling body **30** and cage **10** here is likewise designed in the form of a snap-fit connection. The rolling-body pocket **12** here is embodied such that it encloses or surrounds the rolling bodies **30** from two sides (overlap), and therefore the roller-form rolling body **30** is retained in the cage **10**. At the same time, the amount of overlap is selected to be small enough for the elastic property of the cage material coupled with simple manual force to be sufficient to allow the rolling-body pocket to be expanded elastically in order for the rolling body **30** to be clicked/snap-fitted into the rolling-body pocket **12**.

The rolling-body pockets **12** are designed to be wider in the circumferential direction than the sprag pockets **11**. In other words, the first crosspieces **13** are at a smaller distance from one another than the second crosspieces **14**.

The level of elasticity of the cage **10**—in particular the level of elasticity of the crosspieces **13**, **14**—is higher than the level of elasticity of the sprags **20** and the rolling bodies **30**. This higher level of elasticity of the crosspieces **13**, **14** is achieved, in particular, by the cage **10** (or at least the crosspieces **13**, **14**) being produced from a material which has a higher modulus of elasticity than the materials from which the sprags **20** and the rolling bodies **30** are produced.

FIG. **5** shows an example of the freewheeling element **1** being installed in a gap **40** between an inner, first (fully) cylindrical component **50** and an outer, second hollow-cylindrical component **60**. The dimensions and the shape of the components **50** and **60** here should be considered to be purely illustrative. The first component **50** is arranged coaxially in relation to the second component **60**. The freewheeling element **1** is arranged within said gap **40**. In a clamping position, the sprags **20** form a frictionally fitting connection with the first component **50** and the second component **60**. In a freewheeling position, in contrast, the sprags **20** allow the first component **50** to rotate relative to the second component **60**. Each of the crosspieces **13** has a spring-loading surface. In the freewheeling position, the adjacent sprag **20** is in contact with this spring-loading surface. More precisely, in the freewheeling position, surface-area contact and/or an overlap forms between the spring-loading surface of the crosspiece **13** and the adjacent sprag **20**. In the clamping position, in contrast, the sprag **20** is not in contact with the spring-loading surface of the crosspiece **13**.

Both in the clamping position and in the freewheeling position, the rolling bodies **30** are in contact with the first component **50** and the second component **60** and provide for

low-friction mounting of the two components **50** and **60**. In this way, the freewheeling element **1** has a high load-bearing capacity and, at the same time, can serve as a direction-dependent clutch.

The freewheeling element **1** illustrated in the figures therefore has a cage **10**, a plurality of sprags **20**, and a plurality of rolling bodies **30**. The sprags **20** and the rolling bodies **30** are accommodated in the sprag pocket **11** and the rolling-body pocket **12**, respectively, by means of latching or snap-fit connections. The cage **10** has a higher level of elasticity than the sprags **20** and the rolling bodies **30**. The total of three rolling-body pockets **12** are distributed in an equidistant manner over the circumference of the cage **10**.

The invention claimed is:

1. A freewheeling element having:

a cage,

a plurality of sprags, wherein each of the sprags is accommodated in a respective sprag pocket formed in the cage, and

a plurality of rolling bodies, wherein each of the rolling bodies is a cylindrical roller accommodated in a respective rolling-body pocket, formed in the cage,

wherein the cage has a higher level of elasticity than the sprags and the rolling bodies,

wherein two or more of the plurality of sprag pockets are formed, between adjacent rolling-body pockets, along a circumference of the cage,

wherein the rolling bodies are accommodated in the rolling-body pockets in a removable latching or snap-fit connection, and

wherein the sprags are accommodated in the sprag pockets in a removable latching or snap-fit connection.

2. The freewheeling element of claim **1**, wherein the rolling-body pockets are distributed in an equidistant manner along a circumference of the cage.

3. The freewheeling element of claim **2**, wherein the rolling bodies are accommodated in the rolling-body pockets in a form-fitting manner.

4. The freewheeling element of claim **1**, the respective rolling-body pockets consisting of an odd number of rolling-body pockets.

5. The freewheeling element of claim **4**, wherein exactly three, five or seven rolling-body pockets are formed.

6. The freewheeling element of claim **1**, wherein the sprags are accommodated in the sprag pockets in a form-fitting manner.

7. The freewheeling element of claim **1**, wherein the cage consists of a polymer material.

8. The freewheeling element of claim **7**, wherein the polymer material contains fillers.

9. The freewheeling element of claim **7**, wherein the polymer material contains fillers, specifically fibers and/or balls.

10. The freewheeling element as of claim **1**, wherein the cage consists of a glass-fiber-reinforced polyamide.

11. The freewheeling element of claim **1**, wherein the cage consists of a polyamide.

12. The freewheeling element as of claim **1**, wherein the cage consists of a glass-fiber-reinforced polyamide, specifically PA 66 GF 25.

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